**Phases of the Moon**

- We see the moon by reflected sunlight
- The moon undergoes phases
  - Starts out dark
  - Over a period of two weeks, the moon gradually becomes full
  - After the moon’s disk is fully visible, it begins to fade for two weeks
- The phases are caused by the moon orbiting around the Earth
  - Not related to the shadow of the Earth

**Motion of the Moon**

- The sun moves about 1/12 of the way around the Sun while the Moon makes one trip around the Earth
- How much we see of the Moon depends on our vantage point on Earth
- The moon is said to be “new” when it is in the general direction of the Sun
  - Invisible to us on Earth
- The moon is said to be “full” when it is in the opposite direction from the Sun

**Sidereal and Synotic**

- The Sidereal period of the Moon is the time it take to return to initial position with respect to the stars
  - 27.32 days
  - Time to complete on period
- The Synotic period of the Moon is the time it takes for Moon to return to its initial position with respect to the Sun
  - 29.53 days
  - Time to go through all the phases of the moon

**Phases of the Moon - Pictorial**
**Moon Rise**

- When the Moon is full, it rises at sunset and sets at sunrise
- When Moon is at first quarter, it rises around noon and sets around midnight
- When the Moon is at third quarter, it rises at midnight and sets at noon
- The Moon is 30 Earth diameters away and the orbit of Moon is not exactly in the same plane as the orbit of the Earth around the Sun
  - Eclipses are unusual

**Rotation of the Moon**

- The Moon rotates about its north and south pole like the Earth
- The period of this rotation is equal to the time it takes to orbit the Earth
  - One side of the Moon always faces the Earth

**The Formation of Tides**

- Water on the side of the Earth facing the Moon is drawn to it and water opposite the Moon bulges outward
- We would expect two tides per day but friction, the speed of the Earth’s rotation, and shallow water make the actual tides complicated

**Tides on Earth**

- Some areas of the Earth have large variations in sea level (tides) and some areas have little or no variation in sea level
- Depends on block land masses and ocean depth
- One spectacular example is Mont Saint Michel in Normandy, France
The Effect of the Sun on Tides

- Tides are also affected by the Sun but the effect is only about half of the Moon’s effect.
- Tides are affected by the relative position of the Moon and Sun.

Eclipses of the Sun

- The Moon usually subtends a smaller angle than the Sun.
- Sometimes the Moon is closer to the Earth and can completely block the Sun.

Eclipses of the Moon

- A lunar eclipse occurs when the Moon enters the shadow of the Earth.
- The Earth’s shadow is the width of 4 Moons so the Moon can disappear for some time.
- A lunar eclipse is visible by anyone who can see the Moon.
- The Moon can pass through the dark shadow (umbra) or the partial shadow (penumbra).